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| 09/881,407 | 06/13/2001 | Zhongze Wang | MI22-1670 | 8493 |

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EXAMINER

PERKINS, PAMELA E

ART UNIT PAPER NUMBER

2822

DATE MAILED: 12/19/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/881,407

Applicant(s)

WANG, ZHONGZE

Examiner

Pamela E Perkins

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 13 June 2001.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-43 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-43 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 13 June 2001 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 2,3,4.
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

DETAILED ACTION

This office action is in response to the filing of the application papers on 13 June 2001. Claims 1-43 are pending.

Information Disclosure Statement

The information disclosure statement filed 15 October 2001 fails to comply with 37 CFR 1.98(a)(2), which requires a legible copy of each U.S. and foreign patent; each publication or that portion which caused it to be listed; and all other information or that portion which caused it to be listed. It has been placed in the application file, but the information referred to therein has not been considered.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 6-9, 11, 12, 16-19, 21, 22, 36-39, 41 and 42 are rejected under 35 U.S.C. 102(b) as being anticipated by Chau (5,763,922).

Chau discloses a method of forming a transistor device where a silicon-comprising surface of silicon dioxide (402) is exposed to activate nitrogen to convert the silicon-comprising surface (402) to a material comprising silicon and nitrogen (416); the activated nitrogen being formed by exposing a nitrogen-containing precursor to a

plasma maintained at a power of 500 watts to 2,000 watts; providing a channel region (230, 270) on one side of the silicon and nitrogen surface (220, 260); forming a plurality of PMOS (250) or NMOS (210) transistor gate structures on a side of the silicon and nitrogen surface (220, 260) opposed to the one side and forming a pair of source and drain regions (216, 256) separated from one another by the channel region (230, 270) (col. 3, line 4 thru col. 6, line 20). Chau further discloses dividing the transistor gate structures into a first group and a second group and forming a mask (508) over the second group during the exposure step (Fig. 5D; col. 7, lines 33-63). Chau also discloses the plasma as a remote relative to the silicon-comprising surface and the plasma contacting the silicon-comprising surface (col. 6, line 67 thru col. 7, line 3). Chau discloses implanting a dopant into the channel region with a concentration between 1×10^{16} atoms/cm³ to 1×10^{17} atoms/cm³ (col. 5, lines 48-65).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1-4, 26-31, 33 and 34 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chau in view of Kamath et al. (6,436,845).

Chau discloses a method of forming a transistor device where a silicon-comprising surface of silicon dioxide (402) is exposed to activate nitrogen to convert the

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silicon-comprising surface (402) to a material comprising silicon and nitrogen (416); the activated nitrogen being formed by exposing a nitrogen-containing precursor to a plasma maintained at a power of 500 watts to 2,000 watts; providing a channel region (230, 270) on one side of the silicon and nitrogen surface (220, 260) ; forming a plurality of PMOS (250) or NMOS (210) transistor gate structures on a side of the silicon and nitrogen surface (220, 260) opposed to the one side and forming a pair of source and drain regions (216, 256) separated from one another by the channel region (230, 270) (col. 3, line 4 thru col. 6, line 20).

Chau further discloses dividing the transistor gate structures into a first group and a second group and forming a mask (508) over the second group during the exposure step (Fig. 5D; col. 7, lines 33-63). Chau also discloses the plasma as a remote relative to the silicon-comprising surface and the plasma contacting the silicon-comprising surface (col. 6, line 67 thru col. 7, line 3). Chau discloses implanting a dopant into the channel region with a concentration between 1×10^{16} atoms/cm³ to 1×10^{17} atoms/cm³ (col. 5, lines 48-65). Chau does not disclose the activated nitrogen forming a peak concentration of at least 15 atomic %.

Kamath et al. disclose a method of forming a transistor device where nitrogen is activated in a silicon-comprising surface. Kamath et al. further disclose the activated nitrogen having a concentration of about 20 atomic % (col. 5, lines 23-53). It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Chau by the activated nitrogen having a concentration of about 20 atomic %

as taught by Kamath et al. to reduce tunneling between the transistor gate and the channel region.

Claims 5, 14, 15, 24 and 25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chau in view of Kamath et al. as applied to claims 1-4, 6-9, 11, 12, 16-19, 21, 22, 36-39, 41 and 42 above, and further in view of Schindler et al. (5,962,069).

Chau discloses a method of forming a transistor device where a silicon-comprising surface of silicon dioxide (402) is exposed to activate nitrogen to convert the silicon-comprising surface (402) to a material comprising silicon and nitrogen (416); the activated nitrogen being formed by exposing a nitrogen-containing precursor to a plasma maintained at a power of 500 watts to 2,000 watts; providing a channel region (230, 270) on one side of the silicon and nitrogen surface (220, 260); forming a plurality of PMOS (250) or NMOS (210) transistor gate structures on a side of the silicon and nitrogen surface (220, 260) opposed to the one side and forming a pair of source and drain regions (216, 256) separated from one another by the channel region (230, 270) (col. 3, line 4 thru col. 6, line 20).

Chau further discloses dividing the transistor gate structures into a first group and a second group and forming a mask (508) over the second group during the exposure step (Fig. 5D; col. 7, lines 33-63). Chau also discloses the plasma as a remote relative to the silicon-comprising surface and the plasma contacting the silicon-comprising surface (col. 6, line 67 thru col. 7, line 3). Chau discloses implanting a dopant into the channel region with a concentration between 1×10^{16} atoms/cm³ to 1×10^{17} atoms/cm³

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(col. 5, lines 48-65). Chau does not disclose annealing the silicon and nitrogen surface at a temperature of about 900 °C for a time between 10 seconds and 60 seconds, by rapid thermal processing at a temperature ramp rate of at least 10 °C/second.

Schindler et al. disclose a method of forming a transistor device where a silicon and nitrogen layer is formed on a substrate. Schindler et al. further disclose annealing the silicon and nitrogen surface at a temperature between 500 °C and 850 °C for a time between 5 seconds and 300 seconds, by rapid thermal processing at a temperature ramp rate between 1 °C/second and 175 °C/second (col. 10, lines 29-61). It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Chau by annealing the silicon and nitrogen surface at a temperature between 500 °C and 850 °C for a time between 5 seconds and 300 seconds, by rapid thermal processing at a temperature ramp rate between 1 °C/second and 175 °C/second as taught by Schindler et al. to prepared the surface for further processing steps.

Referring to claims 10, 20, 32 and 40, Chau discloses the power in which the plasma is maintained of claims 10, 20 and 40 wherein the power is between 500 watts and 2,00 watts. It is noted that the specification contains no disclosure of either the critical nature of the claimed concentrations or any unexpected results arising there from. It would have been obvious to one of ordinary skill in the art to maintain the plasma at a power between 1,500 watts and 5,00 watts since it has been held that "In such an situation, the applicant must show that the particular range is critical, generally by showing that the claimed range achieves unexpected results relative to the prior art

range.” In re Woodruff, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990) See MPEP § 2144.05.

Referring to claims 13, 23, 35 and 43, Chau discloses the temperature in which the silicon-comprising surface is maintained of claims 13, 23 and 43 wherein the temperature is 800 °C. It is noted that the specification contains no disclosure of either the critical nature of the claimed concentrations or any unexpected results arising there from. It would have been obvious to one of ordinary skill in the art to maintain the temperature of the silicon-comprising surface between 25 °C and 400 °C since it has been held that “In such an situation, the applicant must show that the particular range is critical, generally by showing that the claimed range achieves unexpected results relative to the prior art range.” In re Woodruff, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990) See MPEP § 2144.05.

Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Jang et al. (6,436,771) disclose a method of making a transistor where nitrogen is activated in a silicon-comprising surface.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Pamela E Perkins whose telephone number is (703) 605-4299. The examiner can normally be reached on Monday thru Friday, 9:00am to 5:30pm.

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If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Amir Zarabian can be reached on (703) 308-4905. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 872-9318 for regular communications and (703) 872-9319 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

pep

December 14, 2002



AMIR ZARABIAN
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